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THE TOAD

This leaflet is prepared for the information of correspondents. With the exception of the section relating to food habits, the technical and other matter represents a compilation of investigations of various authors and is intended to summarize and popularize the various phases of the toad's economy.

INTRODUCTION

Some form of toad can be found in every State in the Union. On the Pacific Coast of North America toads range from the Kenai Peninsula, Alaska, on the north, to La Paz, Lower California, on the south. To the eastward forms other than that with which this account deals occupy the region limited by the Canadian boundary on the north and the Mississippi River on the east, some of them ranging southward into Central and South America.

The common toad, Bufo americanus, with which this account is chiefly concerned, has been found as far north as southern Labrador and in the vicinity of Fort George, on the eastern shore of Hudson Bay, Canada. Its westward range terminates, according to environmental conditions, somewhere between the 95th and 100th meridians. The common toad has also been found in eastern Texas, Louisiana, and Georgia. It is the commonest toad present in the eastern United States and is much more abundant south of the Great Lakes than farther north.

LIFE HISTORY OF THE TOAD

The time of appearance of the toad in spring varies with locality and temperature. In the Northern States toads have emerged from their winter hibernation retreats as early as the middle of March, but the majority of the individuals appear after April 1. When the toad emerges in spring it proceeds to some shallow pool or overflow of a stream. The males usually precede the females to the water, but do not commence to sing until about the third week in April, or as late as May, according to latitude.

It is not unusual to find hundreds of toads congregated in a small pond during the spawning season. Under normal conditions, if mated in the water, the female begins laying at once, and may lay from four thousand to fifteen thousand eggs, the process being usually completed within one day unless there should be a sudden drop in temperature. The eggs are laid in long spiral strings of jelly. The hatching period depends upon the temperature. Below 65° it requires 8 to 12 days, and above that temperature 3 to 8 days. Toads are thus born in the water and in it spend their early life in a larval, fish-like state, breathing by means of gills. The transformation of a tadpole to a young toad takes place sometime between 50 and 65 days after birth and under abnormal conditions it has required 200 days.

If the weather is moderate, toads may remain active from March to the

middle of November. During the winter months they hibernate in the ground, and statements regarding their being found under leaves, boards or stones probably refer to temporary refuges sought after a too hasty emergence in spring or before beginning their real hibernation in fall. The toad makes its burrow with its hind legs and always goes down backwards; the hind feet possess a spur which is of assistance in digging. As the animal descends, the dirt fills in over its head. It was formerly thought that toads burrowed down into the mud around ponds and became encysted in balls of clay. It has been found that those toads which fail to burrow below the frost line perish. Newton has found also by a series of well-conducted experiments that the toad usually digs deeper as the frost level comes nearer to it. Terrestrial amphibians can tolerate high temperature with moisture, but they quickly succumb to cold and drought. Toads, which possess drier skins than frogs, habitually avoid the sunshine, and conceal themselves during the day in holes or crevices.

CHECKS ON THE INCREASE IN NUMBERS OF TOADS.

The common toad formerly was rather abundant in almost every locality throughout its range where sufficient cover existed for concealment during the day. To-day, in some sections, toads are becoming very rare, being destroyed by all classes of vertebrates, and by drought in summer, and severe cold in winter.

With the settlement of the country the toad has had to contend not only with man's inventions but also with his domesticated animals. Young toads are diurnal and thus expose themselves to more enemies than do the adults. Ducks, chickens, and guinea fowls eat the young whenever they find them hopping about in the gardens, roadsides, or meadows; and young snakes find baby toads an easy prey. The sewer systems of the large cities destroy large numbers. Adult toads are mainly crepuscular or nocturnal in their feeding and are attracted to the public highways by the lights of passing automobiles, which also have contributed to their destruction. The burning over of the fields and woods in fall is causing a steady decrease in their numbers.

A water beetle has been known to eat nearly 5,000 toad larvae in a single day. Newts, or salamanders, and fishes also destroy large numbers of the young larvae. From the time the eggs are laid, when they may be spoiled by decay or by mold (Saprolegnnia), until death of adults of old age, there is no period when larva or adult is not subject to attack. When ponds dry up during May and June, large numbers of tadpoles are killed. Many young toads which have just emerged perish before they find some damp sheltered retreat. Probably many of the young succumb during severe cold in winter because they do not burrow so deep in the soil as do the more experienced and stronger adults.

LONGEVITY

In spite of the dangers and natural enemies they are exposed to, some toads live for many years. One account, which is no doubt authentic, concerns

a toad which was accidentally killed when it was known to be 36 years old. Another account more interesting than realistic relates to toads found in terra-cotta vases near Orsay, France, which according to tradition were dressed in green velvet by a sorceress, and were thought to be 200 years old. Statements which relate to toads being found sealed up in rocks or walls or within cavities in living trees usually are inventions or can be explained in an entirely different manner from the account given by the authors. Buckland has conducted some careful experiments along this line. Toads were confined in especially constructed cavities in blocks of limestone and sandstone, and these blocks were buried three feet deep in the garden. The toads confined with sandstone were found dead when the boxes were opened at the end of 13 months; those confined with limestone died before the end of two years. Brooks has shown experimentally that a toad can live a year when sealed up within a block of limestone. It is known that a toad can live for some time without food, but the duration of an enforced period of starvation depends largely on the temperature, that is, on whether or not the toad is kept in a state of hibernation.

POISONOUS SECRETIONS OF TOADS

In most toads the skin is covered with warts, which are more closely aggregated on the sides of the neck than elsewhere, and these, together with a pair of large glandular masses (the parotoid glands) situated behind the eyes, secrete a milky poisonous fluid whenever the animal is molested. This secretion protects the toad against most animals, but not against snakes or birds of prey. Skunks are known to eat toads, but before doing so they are said to roll them about roughly with their paws until the poison has been discharged from the glands and rubbed off. A dog may bite a toad once, but the experience usually proves to be so disagreeable, because of the effect on the mucous membrane of the mouth, that he rarely can be induced to repeat the performance. The secretion is an acrid irritant, causing pain in cuts and producing a bitter astringent feeling in the mouth. Some writers believe the female lacks this fluid during the breeding season while the male at the same time has an over-abundant supply of it.

According to Madame Phisalix, toads possess two distinct types of glands, which secrete venom of different properties, one type producing a mucous and the other a granular venom. While the mucous glands are distributed over the entire body, they are principally found on the abdomen. The mucous secretion produced is an alkaloid which acts as a narcotic, its effect being confined to the nerve centers. Glands situated on the back, together with the parotoids behind the neck and connected with them, secrete granular acid venom which acts as a convulsive.

Some of the frogs also produce these venoms in large quantities. The Choco Indians, at San Juan, Grenada, employ a venom obtained from Phyllobates melanorrhinus to poison their arrowheads. It is said that the Indians of Colombia utilize the secretion of Dendrobates tinctorius for the same purpose. The Indians have found a very easy way to secure this poison. The animal is held over a fire and the secretion is then scraped off. Sufficient venom is obtained to poison 50 arrows, and these are principally used for shooting

monkeys. The same poison is used by dealers to produce yellow feathers on the Amazon green parrots. The blue and green feathers of the head and neck are plucked out, and these areas are then rubbed with the back of a living frog. When the feathers grow out again they are a yellowish tint, instead of green or blue.

The venoms of batrachians, like those of snakes, produce fatal results only when introduced into the circulatory system.

TRADITIONS AND LEGENDS

The toad is not an attractive animal and it has always been the object of curious beliefs or superstitions. Small boys believe that if one is killed and turned on its back there will be rain before night. For ages the general public has held to the belief that warts were produced by handling toads. Other traditions credit the toad with the power of poisoning infants with its breath; of bringing good fortune to the house in the new-made cellar of which one is found; of curing children of stammering if rubbed on the back of the neck; and of causing a cow to go dry or give bloody milk, if she accidentally kills a toad while being driven home from the pasture. The works of the early writers on natural history teem with vague unsubstantiated accounts of the venomous qualities of the breath and sputum of the toad, the medicinal value of toad skins for treating certain ailments, and the valuable toadstone or jewel to be found in its head.

FOOD HABITS

The common toad is chiefly terrestrial ever though at certain seasons of the year it is found in the vicinity of, or floating in shallow streams, ponds, or temporary pools of water. It is more or less crepuscular. In capturing various forms of animal life it shows that dead or motionless food is of little interest. Only moving objects, apparently, make any impression on its sensory apparatus, but motion perceived, the toad will refuse no insect, spider, milliped, or snail which it can swallow. A toad's tongue is attached at the front end of the mouth, and is free behind. It is thus an organ especially adapted for flinging forward and capturing insects and other active forms of animal life. Frequently objects are accidentally swallowed which have no direct food value, such as the needles of various coniferous trees. Toads have even swallowed small marbles which were rolled in front of them, and small boys have many times fed toads with burning match heads, which the victim perhaps mistook for fireflies.

FOOD OF THE TOAD

An examination of the stomachs of 502 common toads, Bufo americanus, has served to corroborate in a general way the previous research of Kirkland (published in Farmers' Bulletin 196). Animal matter constitutes 89 percent of the total food for the season. Vegetable matter forms more than 8 percent, but since it consists of the needles of various coniferous trees, grasses, bits of rotten wood and bark, and seeds of various plants, as well as leaves, this

portion must have been swallowed by accident and can not properly be classed as food. Inorganic material found in the stomachs averages about 2 percent of the total and consists mainly of sand, gravel, or small pebbles, and in a few instances of coal and ashes.

Earthworms, sowbugs, snails, spiders, millipeds, and insects are the main types represented in the animal food. Earthworms were found in only six stomachs and represent less than 1 percent of the total food, while insects were found in practically every stomach and comprise nearly 77 percent.

Small forms of Crustacea, known locally as sowbugs, forms which prove nuisances in greenhouses because of their habit of feeding on the roots of flowering plants, as pansies, violets, and the like, comprise less than 1 percent. Snails compose a little more than 1 percent of the total food for the season.

Long-legged, spiderlike animals, which from their prevalence during the haying season have been called harvestmen and are known also as daddy-longlegs, were identified in 46 stomachs and constitute nearly 1 percent of the season's food of the toad. Spiders are eaten throughout the season, but, while nearly 600 of them were found in the 500 stomachs examined, they constitute only 2.8 percent of the total food. Millipeds were present in about one of every five stomachs examined, the largest number found in a single stomach being 70.

Beetles (Coleoptera) are taken throughout the season and form more than 42 percent of the total food. These represent 56 families, but the ground beetles, scarabaeids, weevils, darkling beetles, click beetles, and rove beetles, in the order named, are most commonly eaten. The Carabidae, or ground beetles, constitute the largest element of the food furnished by the Coleoptera, approximately 18 percent of the toad's food being from this source. In point of numbers taken, most of the carabids are those known to be plant-feeding beetles. The dung beetles and leaf-chafers, or scarabaeids, form the second largest item under the Coleoptera, as they contribute 7 percent of the total food. In 215 of the 502 stomachs examined 573 weevils, representing 93 forms, were present. Click beetles constitute 2 percent of the season's food. While rove beetles (Staphylinidae) are rather frequently eaten, they are usually of small size, and in consequence form little more than 1 percent of the total food. Many other families of beetles were taken by toads in varying proportions and of these the leaf beetles, longhorned beetles, ladybird beetles, and fireflies are the most important. It may be stated that in general toads will eat any beetle that happens to come within reach and that the relative percentages of the various families of beetles found in the course of the stomach examinations agree very closely with the abundance in individuals of those families which live on or near the ground.

In all months except May, ants formed the largest single item in the toad's food. The relative proportions of ants to other Hymenoptera, including ichneumons, in the food, also show how closely the terrestrial

feeding habits of the toad influence its captures of members of this order. Since the total bulk of Hymenoptera other than ants taken during the entire season amounts to only 1.5 percent, their destruction is of relatively little importance.

Caterpillars (Lepidoptera) were identified in 179 stomachs, being identified as cutworms in 46 cases. Notwithstanding the abundance of grasshoppers and crickets (Orthoptera) in most places, they form a small portion of the toad's food. Flies (Diptera) belonging to 28 families were identified in the stomach contents, and although taken rather frequently, they constitute only 2 percent of the season's food; while many are innocuous forms, others represent predacious, carnivorous, or blood-sucking species. Bugs (Hemiptera) form about 2 percent of the total food for the season, although during May they constitute nearly 8 percent. Caddis flies (Trichoptera) constitute 2 percent of the food in July, but average for the entire season less than 1 percent.

CONCLUSIONS

The evidence for and against the toad as shown by the stomach contents of 502 common toads may be summarized as follows:

Toads are beneficial when they eat myriapods, sowbugs, Orthoptera, May beetles, leaf beetles, weevils, and caterpillars. The percentage by bulk of that portion of the total food which consists of noxious animals is not offset by an equal amount of animals beneficial to man. The number of beneficial carabid beetles, ladybird beetles, ichneumons, and spiders destroyed by toads does not seriously disturb the balance of nature. Under certain conditions, as in greenhouses, gardens, farms, fields of small grain, or golf courses, toads are of service to man. Granting that the toad may be indiscriminate in the selection of food, in any of the above situations noxious insects and other invertebrates are sure to predominate, hence the bulk of the toad's food consists of injurious forms. The value of the toad can hardly be defined on a dollar and cents basis, for toads are never numerous enough in any locality to be of especial economic importance. Furthermore, unlike birds, they are not endowed by nature with the ability to traverse wide stretches of land in order to aid in combating abnormal local increases of insects and the like.

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